PXIE MEBT
Buncher Cavity

Pre-Design Review

Goals

It is an initial phase of the cavity design efforts. The goal is, based on the existing FRS (docbase #1071), to converge of the **technical specifications** for the cavity, define ways how elements of the cavity should be designed, and what fabrication (including brazing and finishing) and acceptance (including low-power intermediate RF measurements) steps are needed for commissioning.

FRS

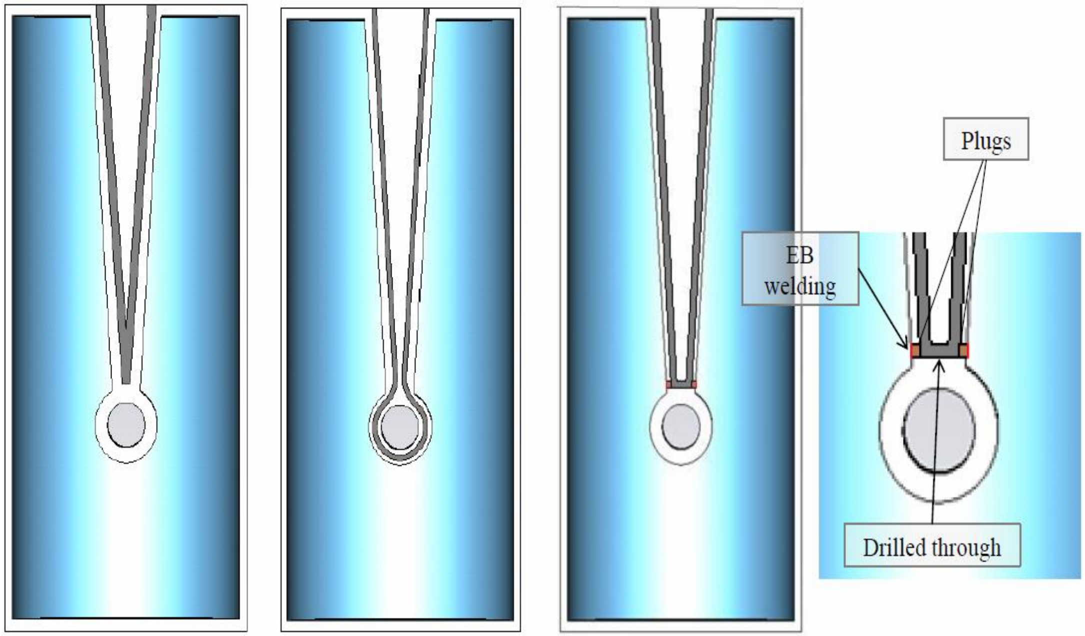
PXIE docbase #1071

General			
	Minimum beam aperture (ID), mm	30	
	Overall module length; flange-to-flange, m	≤0.35	A request to make it smaller
	Positioning accuracy relative to the projected beam trajectory: X, Y, Z, RMS, mm Pitch and Yaw, RMS, mrad	 0.5 3	
	Cavity vacuum at the operating voltage with no beam, Torr	≤1e-8	Backing, surface finish, pumping speed
Cavity			
	Frequency, MHz	162.5	
	Operating mode	CW	
	Operating temperature, °C	35	
	Nominal accelerating voltage at beta=0.067, MV	0.07	
	Maximum accelerating voltage at beta=0.067, MV	0.10	Cooling
	Power loss at maximum voltage, kW	≤3	
	Frequency tuning range, kHz	100	
	Maximum water supply pressure, Bar	20	

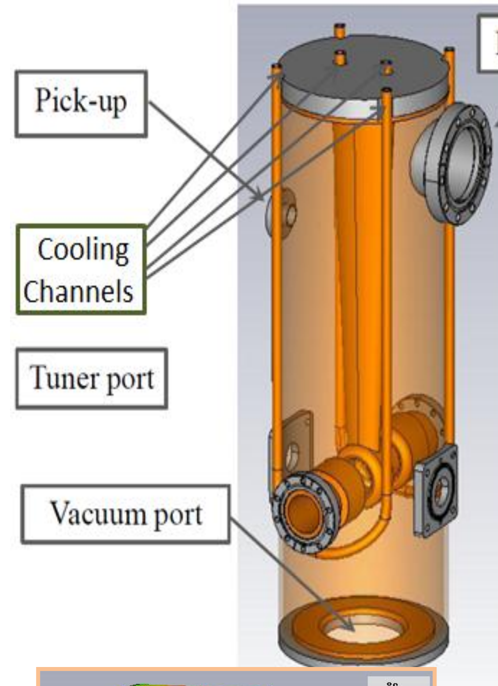
Each cavity must have a provision for use of the next instrumentation:

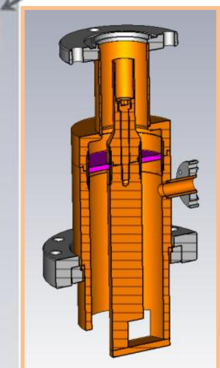
- Cavity field probe.
- RF coupler e-probe.
- Cavity vacuum monitor

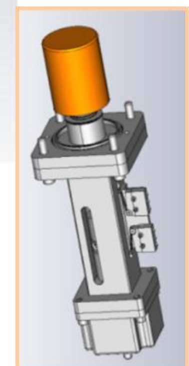
Status as of June 08, 2012

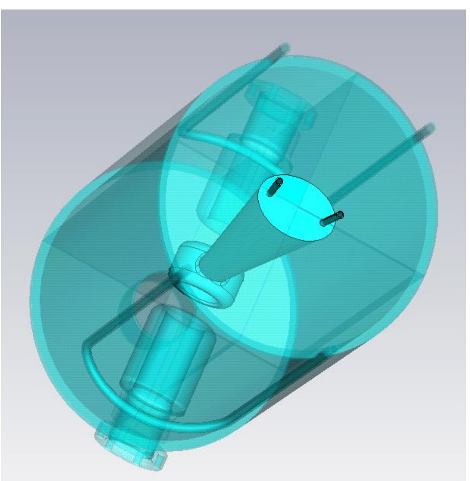


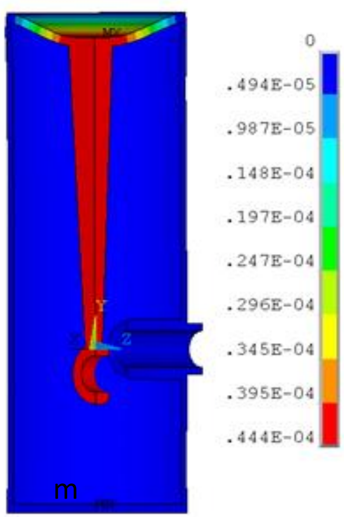
6.9 MPa/ksi

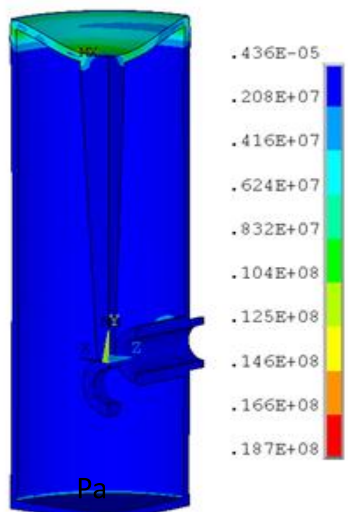


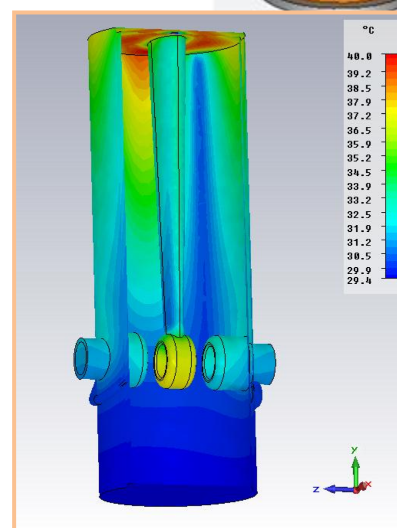




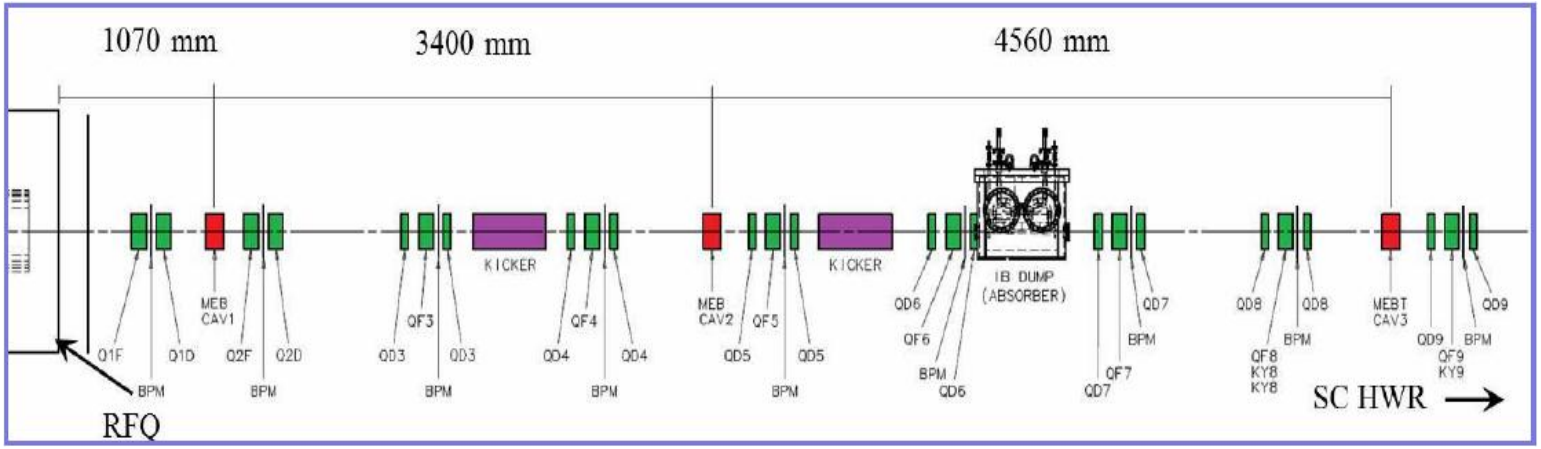


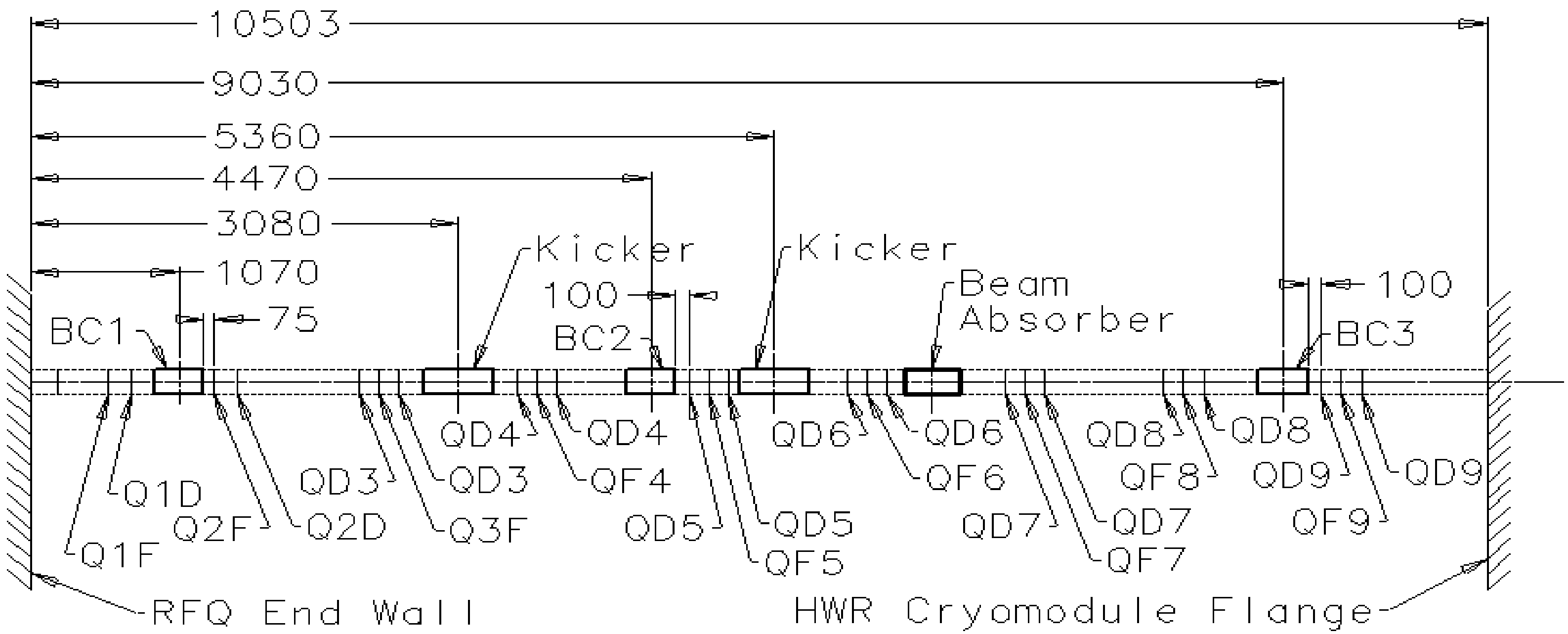




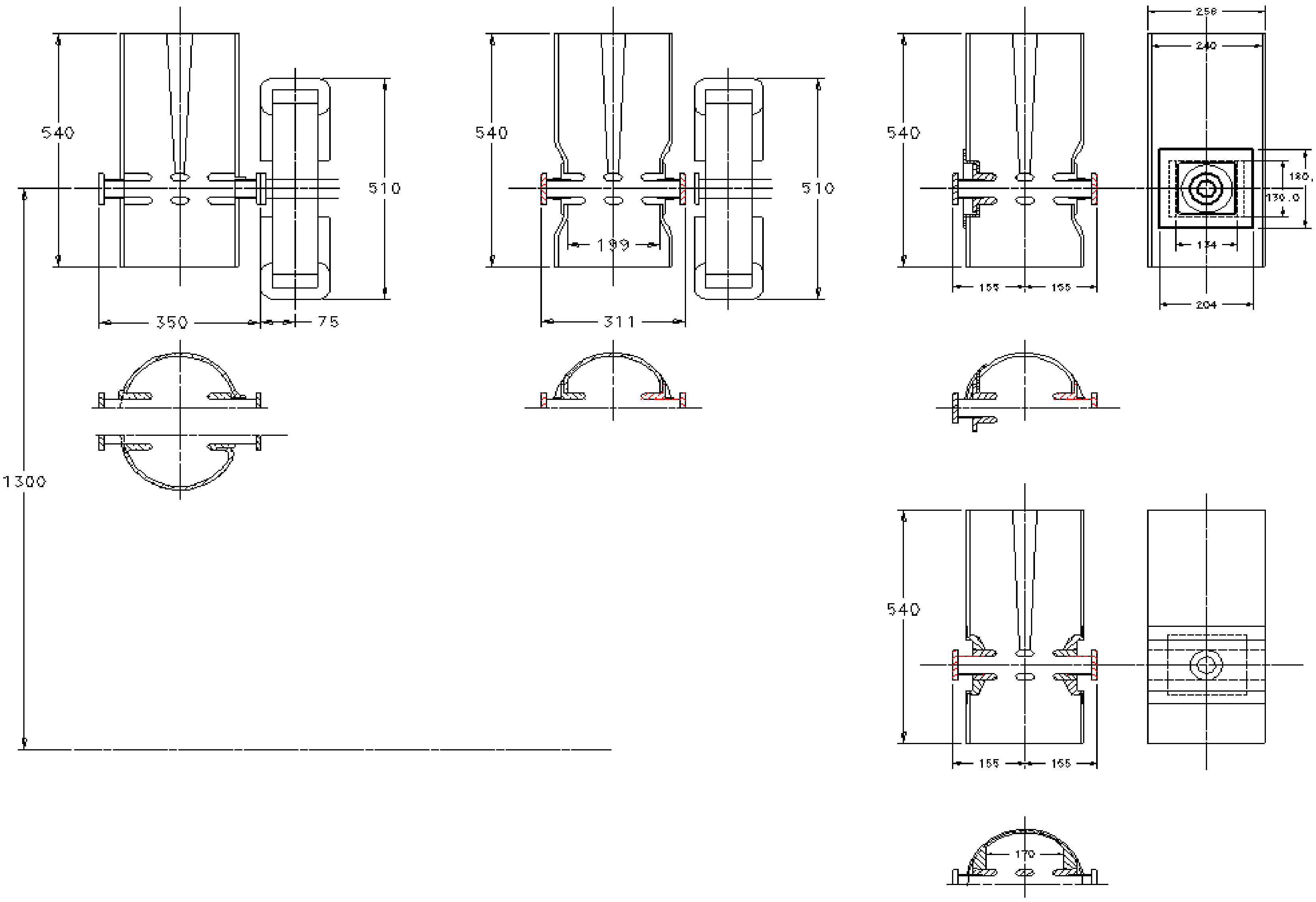


MEBT Layout

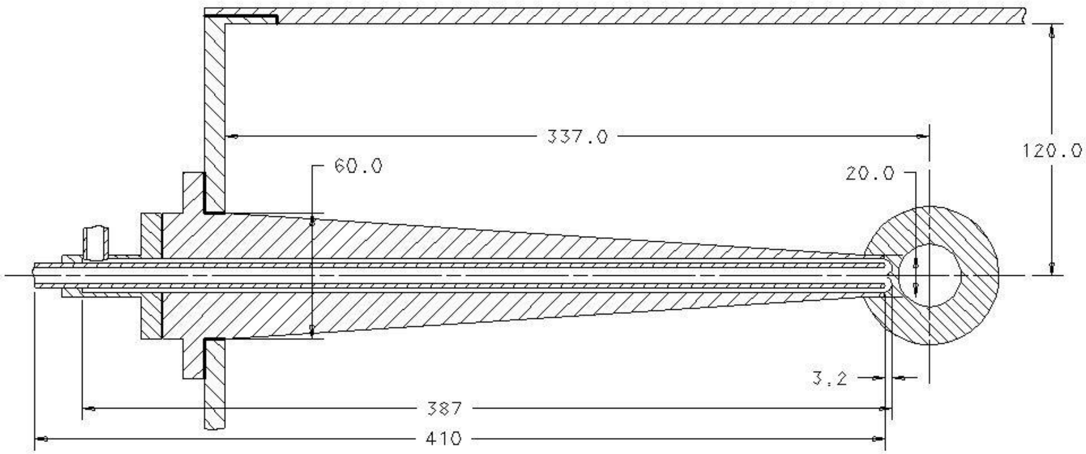

1070 mm
3400 mm
4560 mm
KICKER
KICKER
IB DUMP
(ABSORBER)
MEB
CAV1
MEB
CAV2
MEBT
CAV3
Q1F
Q1D
Q2F
Q2D
BPM
QF3
QD3
QF4
QD4
QF5
QD5
QD6
QF6
QD6
QD7
QF7
QD8
QF8
KY8
QD9
QF9
KY9
RFQ
SC HWR

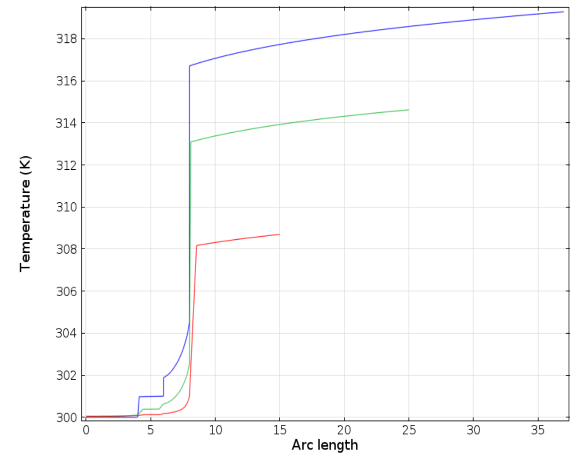

10503
9030
5360
4470
3080
1070
75
100
100
Kicker
Kicker
Beam
Absorber
BC1
BC2
BC3
Q1D
Q1F
Q2F
Q2D
QD3
QD3
Q3F
QD4
QD4
QF4
QD5
QD5
QF5
QD6
QD6
QF6
QD7
QD7
QF7
QD8
QD8
QF8
QD9
QD9
QF9
RFQ End Wall
HWR Cryomodule Flange

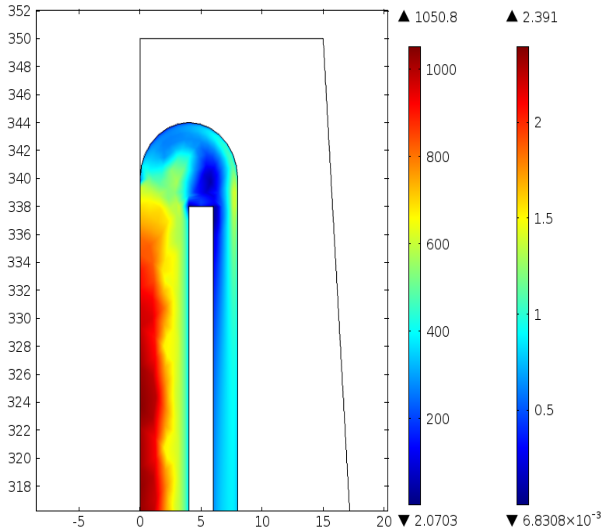
Integration in the Beam Line

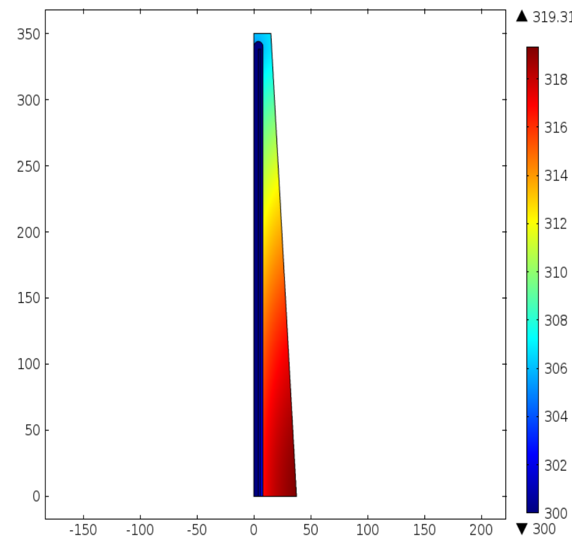


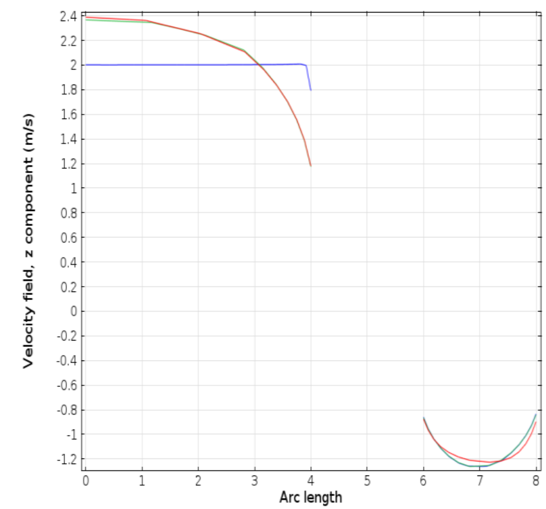
Central Electrode: Cooling







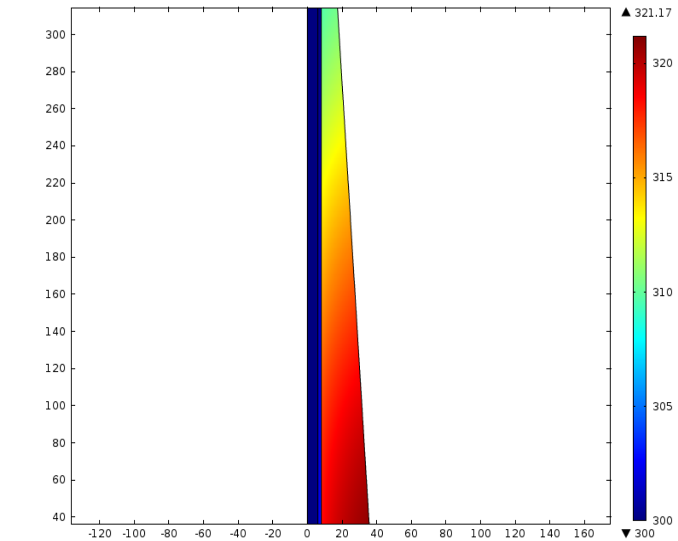




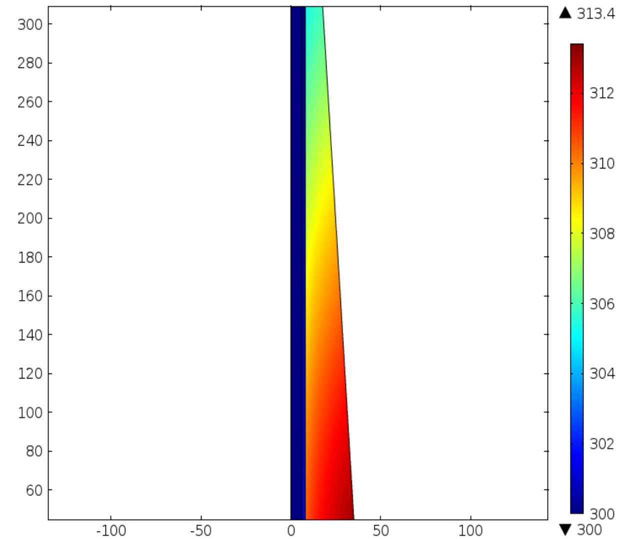
Uniform Heat influx density 20,000 W/m^2. Total Heat flux ~1100 W.
Water velocity at the input is 2 m/s → 1.6 GPM

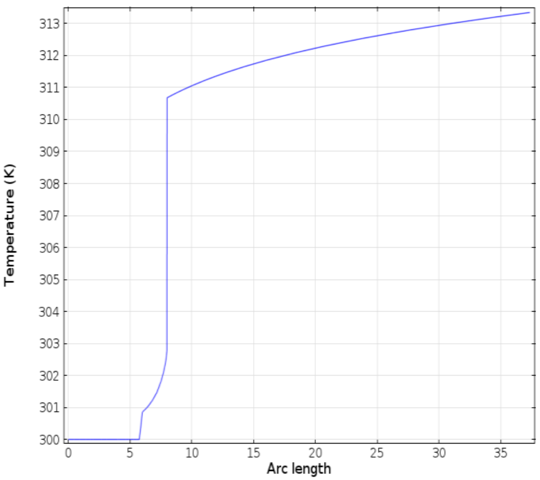
Cooling - Simple

V = 1 m/s

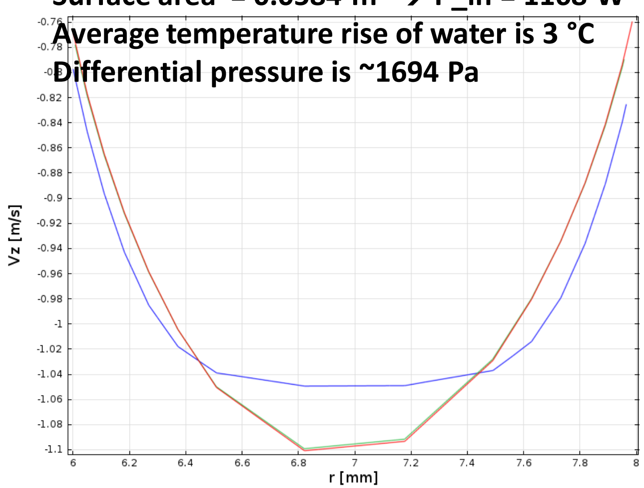


V = 2 m/s

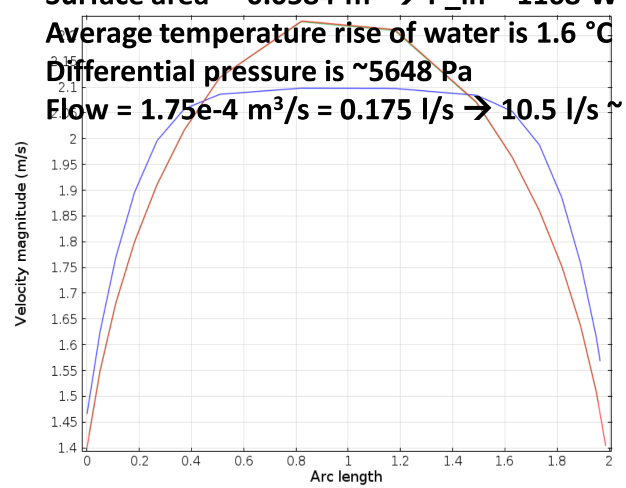




P_in = 1206 W
P_pipe = 1095 W
Convective Flux = 111042-110086 = 956 W
Surface area = 0.0584 m² → P_in = 1168 W
Average temperature rise of water is 3 °C
Differential pressure is ~1694 Pa



P_in = 1207 W
P_pipe = 1062 W
Convective Flux = 22130-220174 = 856 W
Surface area = 0.0584 m² → P_in = 1168 W
Average temperature rise of water is 1.6 °C
Differential pressure is ~5648 Pa
Flow = 1.75e-4 m³/s = 0.175 l/s → 10.5 l/s ~ 3 GPM

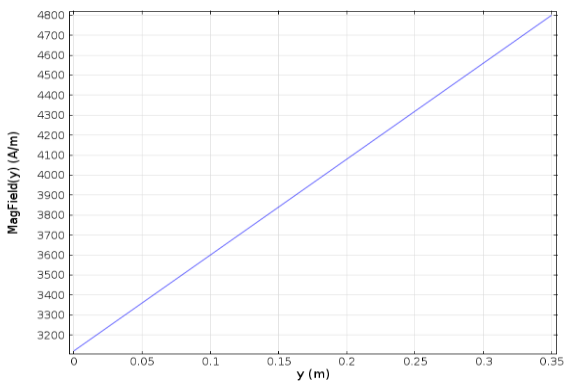


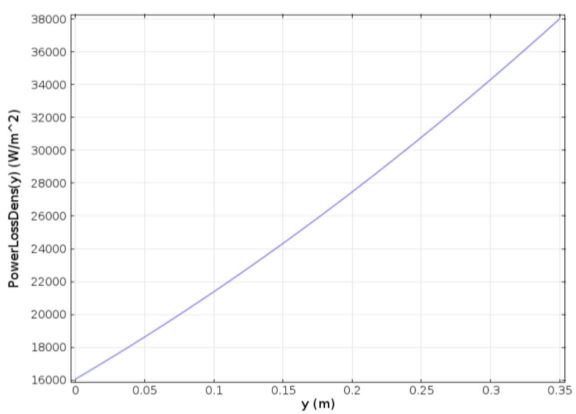
Adding turbulizators reduces the maximum temperature by ~3 K and increases pressure by factor of 2

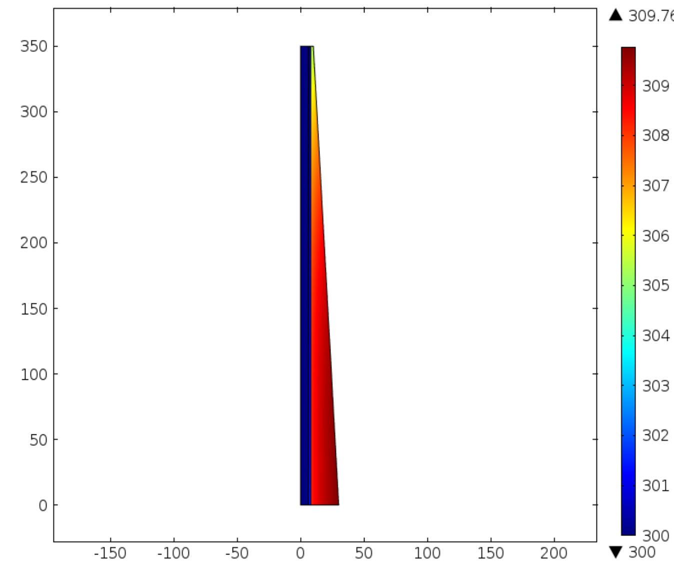
Simplified Geometry of the Central Electrode

Satisfactory results of the cooling study allow using simplified geometry of the cavity: conical stem with round cross-section (Meiyu)

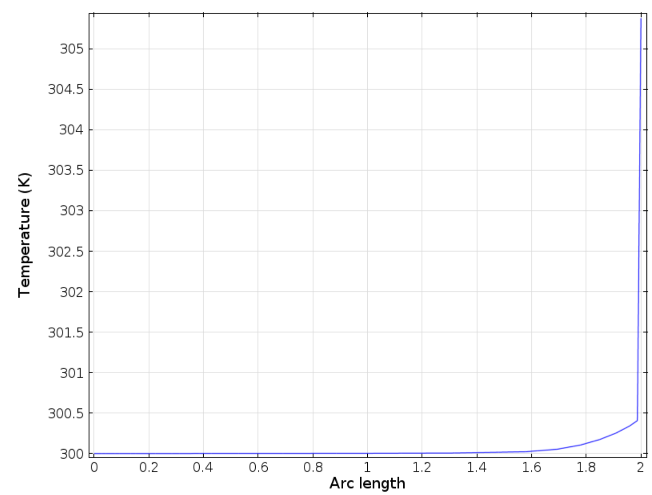
U = 100 kV
P = 1100 W on the central electrode
v = 2 m/s; Diff pressure in the channel – 5700 Pa
Water Flux = 1.76*10^{-4} m^3/s = 0.176 l/s → 2.8 GPM
Heat through convection = 860 W
Total power loss in the cavity = ~1.5 kW







Temperature across the channel



During the Design Stage

1. Get all tuners and power couplers;
2. Decide on a size of all flanges;
3. Decide of the brazing procedure: materials and sequencing;
4. Make a mockup and test water cooling of the central electrode;
5. Define surface finish and fabrication tolerances;
6. Define surface cleaning procedures;
7. Decide on water pressure and flow gauges → buy;
8. Decide on temperature gauges (type and location) → buy;
9. Make a list of potential vendors;
10. Start planning for training and testing;